

Research Article

Assessment of quality of life in relation to spasticity severity and socio-demographic and clinical factors among patients with spinal cord injury*

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Objective: To assess the impact of spasticity severity as well as socio-demographic and clinical factors on quality of life (QOL) and to identify factors predicting poor QOL among patients with spinal cord injury (SCI)

Design: Descriptive cross-sectional study.

Setting: Tertiary care clinic in Istanbul, Turkey.

Participants: A total of 110 patients with SCI (mean (SD) age: 43.8 (14.7) years, 58.2% were males) were enrolled.

Assessments: The American Spinal Injury Association (ASIA) Impairment Scale (AIS), Modified Ashworth Scale (MAS) and Turkish version of the World Health Organization Quality of life questionnaire (WHOQOL-BREF) were utilized to determine the SCI category, severity of spasticity and QOL scores, respectively.

Outcome measures: The WHOQOL-BREF scores were evaluated with respect to the severity of spasticity, aetiology and duration of SCI, AIS category and method of bladder management.

Results: The mean (SD) physical health (41.9 (15.3) vs. 46.5 (10.9), $P = 0.029$), social relationships (45.6 (20.2) vs. 53.8 (17.3), $P = 0.025$) and total WHOQOL-BREF scores were significantly lower in patients with more severe spasticity. Multivariate linear regression analysis revealed that severity of spasticity was a significant predictor of decreased WHOQOL-BREF total scores, physical domain scores and social relations domain scores by 11.381 ($P = 0.007$), 11.518 ($P = 0.005$) and 17.965 ($P = 0.004$), respectively.

Conclusion: In conclusion, addressing QOL in relation to severity of spasticity for the first time among Turkish SCI patients, our findings revealed a negative impact of the spasticity severity on the WHOQOL-BREF scores, particularly for physical health and social relationship domains.

Keywords: Spinal cord injury, Spasticity, Quality of life, Modified Ashworth Scale

Introduction

Spinal cord injury (SCI) is associated with significant functional, psychological, social and economic adverse outcomes due to long-term complications.¹⁻³ Spasticity is one of the most problematic and prevalent (78% to 93% in cervical and 45% to 82% in thoracic injuries)

secondary long-term complications after SCI, as associated with increased functional impairment, contractures, pain and posture disorders.⁴⁻⁹

Given the increased likelihood of surviving the initial injury and having a prolonged life expectancy among patients with SCI, an improved quality of life (QOL) has become an increasingly important target in post-SCI rehabilitation practice.^{3,5-12} Accordingly, QOL assessment become a valuable index to evaluate the success of rehabilitation interventions, progression of SCI and the additional burden of secondary co-morbidities.^{10,13}

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However, there remains a controversy regarding the association of spasticity with QoL in the literature with an indication of poorer QoL in SCI patients with more severe spasticity in some studies,^{14–17} whereas lack of any association revealed between spasticity and QoL in other studies.^{18–20}

In addition, accurate assessment of spasticity is challenging due to a wide range of criteria used to define spasticity and the lack of a valid and reliable tool.^{4,15,21} This seems notable given that determining the severity of spasticity in addition to its presence is quite important in assessing QOL in SCI patients with the likelihood of poorer QOL among patients with more severe spasticity in clinical practice.^{4–7,14,15}

This study was therefore designed to test whether severity of spasticity relates to QOL in patients with SCI, and to identify demographic and clinical correlates of severity of spasticity and poor QOL among patients with SCI.

Methods

Study population

A total of 110 patients with SCI (mean (SD) age: 43.8 (14.7) years; 58.2% males) undergoing inpatient rehabilitation at Istanbul Physical Medicine and Rehabilitation Training and Research Hospital were enrolled in this descriptive cross-sectional study. Exclusion criteria were psychiatric disorders involving psychotic symptoms, recent suicide risk or substance abuse and/or neurological disease, pregnancy, cognitive impairment, the presence of severe orthopaedic deformity affecting the assessment of spasticity and severe systemic disorder.

Written informed consent was obtained from each subject following a detailed explanation of the objectives and protocol of the study, which was conducted in accordance with the ethical principles stated in the Declaration of Helsinki and approved by the institutional ethics committee. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

Assessments

Assessments were performed prior to implementation of inpatient rehabilitation program in each patient via a face-to-face interview with patients, though medical records or application of SCI-related scales and questionnaires by an expert physician. Data on patient demographics (age, sex, marital status, educational status), duration and aetiology (traumatic, non-traumatic) of SCI and type of bladder

management [clean intermittent catheterization (CIC), permanent catheter, normal voluntary voiding] were screened in each patient via face-to-face interviews and through medical records. American Spinal Injury Association (ASIA) Impairment Scale (AIS), Modified Ashworth Scale (MAS) and Turkish version of The World Health Organization Quality of life questionnaire (WHOQOL-BREF) were applied by the same researcher who had expertise in SCI rehabilitation and spasticity to determine SCI category, severity of spasticity and QOL scores, respectively. All data recorded in the Case Report Forms were also crosschecked by different clinicians specialized in SCI rehabilitation to ensure adherence to the study protocol.

Sociodemographic and clinical characteristics of patients with low ($MAS < 2$) and high ($MAS \geq 2$) spasticity severity were determined in addition to the analysis of QOL scores with respect to sociodemographic characteristics, severity of spasticity ($MAS < 2$ vs. $MAS \geq 2$), aetiology of SCI (traumatic vs. non-traumatic), AIS category (complete vs. incomplete) and bladder management.

AIS

AIS is a part of International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) developed by ASIA and International Spinal Cord Society (ISCoS). AIS is a clinician-administered scale used to classify the severity (completeness) of injury in individuals with SCI, based on the identification of sensory and motor levels indicative of the highest spinal level demonstrating “unimpaired” function. AIS is scored on a 5-point ordinal scale from A (sensory & motor complete SCI) to E (normal sensory and motor function) to determine the level of neurological impairment.^{22,23} AIS has been indicated to show very strong inter-rater and test-retest agreement (coefficients > 0.96) for total motor, light touch and pin prick scores alongside a substantial agreement in individual muscle testing ($\kappa = 0.649$ – 0.993) and in motor and sensory levels, ($\kappa = 0.68$ to 0.78).²⁴

MAS

The MAS is used to assess spasticity in plantar flexor and hip adductor muscle groups based on measurement of the resistance to passive stretch with a rating of 0–4 [0: no increase in muscle tone, 1: slight increase in muscle tone (catch or min resistance at end range), 1+: slight increase in muscle resistance throughout the range, 2: moderate increase in muscle tone throughout ROM, PROM is easy, 3: marked increase

in muscle tone throughout ROM, PROM is difficult and 4: marked increase in muscle tone, affected part is rigid in flexion or extension].^{25,26} MAS scores have been indicated to show moderate to substantial inter-rater and test-retest agreement ($\kappa=0.531-0.774$) in patients with SCI.²⁷

WHOQOL-BREF

WHOQOL-BREF is a self-report questionnaire that assesses QOL within the context of an individual's culture, value systems, personal goals, standards and concerns.^{28,29} It contains 26 items that address four QOL domains, including physical health (7 items), psychological health (6 items), social relationships (3 items) and environment (8 items), while the other 2 items measure overall self-perceived QOL and health. Items are rated on a 5-point Likert scale (low score of 1 to high score of 5) leading to a mean score per domain that ranges from 4 to 20. The mean domain score is then transformed linearly to a 0–100-scale, with a higher score indicating a higher QOL. The Turkish version of the WHOQOL-BREF has been validated by Eser *et al.*³⁰ and shown to have adequate internal consistency (Cronbach's Alpha = 0.53–0.83) and test-retest reliability ($r = 0.57-0.81$). WHOQOL-BREF has been used in large epidemiological studies and clinical trials^{28,29} with satisfactory internal consistency and discriminant validity among individuals with SCI.³¹

Statistical analysis

Statistical analysis was performed using NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA). The chi-square test was used for the comparison of categorical variables between spasticity severity groups (MAS <2 vs. MAS \geq 2). QOL scores were analyzed using the independent t-test for socio-demographic, AIS category and spasticity severity groups and with ANOVA and *post Hoc* Tukey tests for the bladder management groups. Correlation of QOL scores with age, MAS and duration of SCI was analyzed via the Pearson correlation test. Predictors of lower physical and social relation domains and total WHOQOL-BREF scores were determined via linear regression models with the inclusion of spasticity severity (MAS <2 vs. \geq 2) and bladder management (normal voluntary voiding vs. catheter use) as the variables. If a variable had a significant effect on the score in the univariate analysis, it was included in the multivariate analysis. Data were expressed as the mean (standard deviation, SD)

and percent (%) where appropriate. $P < 0.05$ was considered statistically significant.

Results

Demographic and clinical characteristics with respect to severity of spasticity

Mean(SD) duration of SCI was 44.8(54.8) months. Traumatic aetiology (63.6%) and incomplete injury (76.4%) were commonly noted and MAS scores were ≥ 2 in 45.5% of patients. Normal voluntary voiding was noted in 20% of patients, while CIC (77.3%) was the most commonly used technique in patients with bladder dependence (Table 1).

No significant difference was found between MAS severity groups with respect to patient demographics,

Table 1 Patient characteristics with respect to spasticity severity.

	Total (n = 110)	Spasticity severity		P value
		MAS <2 (n = 60)	MAS \geq 2 (n = 50)	
Age (year), mean(SD)	43.8(14.7)	43.8(14.7)	44.0(15.0)	0.954 [†]
Duration of SCI (mo.), mean(SD)	44.8(54.8)	40.3(58.1)	48.6(50.9)	0.432 [†]
Sex, n(%)	n(%)	n(%)	n(%)	0.672 [‡]
Male	64 (58.2)	36(60.0)	28(56.0)	
Female	46(41.8)	24(40.0)	22(44.0)	
Educational status, n(%)	n(%)	n(%)	n(%)	0.912 [‡]
High school	26 (23.64)	15(25.0)	11(22.0)	
Vocational school	84 (76.36)	45(75.0)	39(78.0)	
Marital status, n(%)	n(%)	n(%)	n(%)	0.178 [‡]
Single/divorced	39(35.4)	21(35.0)	28(36.0)	
Married	71(64.6)	39(65.0)	32(64.0)	
SCI aetiology, n(%)	n(%)	n(%)	n(%)	0.638 [‡]
Traumatic	70(63.6)	37(61.7)	33(66.0)	
Non-traumatic [§]	40(36.4)	23(38.3)	17(34.0)	
AIS category, n(%)	n(%)	n(%)	n(%)	0.712 [‡]
Complete (A)	26(23.6)	15(25.0)	11(22.0)	
Incomplete (B + C + D)	84(76.4)	45(75.0)	39(78.0)	
Bladder management, n(%)	n(%)	n(%)	n(%)	0.505 [‡]
CIC	85(77.3)	45(75.0)	40(80.0)	
Permanent catheter	3(2.7)	1(1.7)	2(4.0)	
Normal voiding	22(20.0)	14(23.3)	8(16.0)	

AIS, American Spinal Injury Association Impairment Scale; CIC, clean intermittent catheterization; MAS, Modified Ashworth Scale; SCI, spinal cord injury.

[†]Independent t test.

[‡]Chi-square test.

[§]Cervical/ lumbar disc herniation, iatrogenic SCI (failed neck surgery, thoracic spine surgery, failed back surgery and scoliosis/ kyphosis surgery) and tumor.

educational status, marital status, duration of SCI, aetiology, AIS category and bladder management (Table 1).

WHOQOL-BREF scores with respect to aetiology, type and severity of SCI

Total WHOQOL-BREF scores were mean (SD) 48.2 (12.6) in the overall study population. There was a significant association between severity of spasticity and WHOQOL-BREF scores with lower scores for physical health (41.9(15.3) vs. 46.5(10.9), $P = 0.029$) and social relationships (45.6(20.2) vs. 53.8(17.3), $P = 0.025$) domains as well as total WHOQOL-BREF scores (44.7(13.7) vs. 50.6(10.9), $P = 0.014$) in patients with MAS scores of ≥ 2 than MAS scores of < 2 . Physical domain scores on the WHOQOL-BREF scale were also significantly lower in those with permanent catheter use compared to those with voluntary voiding (29.8 (13.5) vs. 47.9(10.5), $P < 0.05$). No significant difference was noted in WHOQOL-BREF scores with respect to sex, educational status, marital status, SCI aetiology and AIS category (Table 2).

Correlation of WHOQOL-BREF scores with age, MAS and duration of SCI

MAS scores were negatively correlated with physical health domain ($r = -0.218$, $P = 0.029$), social relations domain ($r = -0.216$, $P = 0.023$) and total WHOQOL-BREF ($r = -0.215$, $P = 0.022$) scores. No significant correlation was noted between WHOQOL-BREF scores and patient age or duration of SCI (Table 3).

Linear regression analysis for factors predicting poor QOL

Linear regression analysis revealed that the MAS score was a significant predictor of decreased WHOQOL-BREF total scores, physical domain scores and social relations domain scores by 11.381 ($P = 0.007$), 11.518 ($P = 0.005$) and 17.965 ($P = 0.004$), respectively, compared with lower MAS scores (Table 4).

Furthermore, voluntary voiding was found to be a significant predictor of increased WHOQOL-BREF physical domain scores by 3.597 ($P = 0.042$) compared with bladder management via catheter use (Table 4).

Discussion

Our findings revealed a significant role of severity of spasticity in predicting poor QOL in patients with SCI, whereas no association of socio-demographic characteristics, SCI aetiology, AIS category and duration of SCI was noted with severity of spasticity or QOL scores.

Previous studies among SCI patients in Turkey revealed an average age range of 30.6-38.3 years³²⁻³⁴

and a decline in the male/female ratio that ranged from 3.38/2.1 in earlier studies³²⁻³⁴ to 2.49/1,³⁵ 2.31/1³⁶ and 1.55/1³⁷ in more recent studies. In this regard, average age (43.8 years) and male/female ratio (1.39/1) in our cohort seem to support a prolonged life expectancy in SCI patients with a shift to a higher prevalence in the elderly population^{2,3,10,36,38-40} alongside a decline in the male/female ratio for SCI over time.^{32,36,40}

Published reports on factors influencing QOL in SCI patients revealed inconsistent findings.⁴¹ Severity of impairment, duration of injury, age, sex, race, marital and educational status, medical complications, self-perceived health and mobility were reported to be associated with QOL in some studies,⁴¹⁻⁴⁶ while others reported no such associations.⁴⁷⁻⁵⁰

Our findings revealed severity of spasticity but none of sociodemographic (age, sex, marital or educational status) and clinical (duration of SCI, aetiology of SCI and AIS category) factors to predict poorer QOL in SCI patients. Likewise, in past study among SCI patients, severity of spasticity but not severity of injury was shown to correlate with life satisfaction.¹⁵

Improved QOL scores have been associated with increased physical capacity^{45,51} advanced community participation and higher participation in home, work and leisure activities among SCI patients.^{42,47,48,52,53} Besides, severe spasticity has been associated with functional impairment, limited range of motion, pain, restricted daily activities and increased rate for contractures, complications and hospitalizations.^{5,6,15,54-57} In this regard, association of higher MAS scores with poorer QOL, particularly in terms of physical and social relations domains in our cohort supports the association of reduction in spasticity with improved QOL, overall function in daily activities and physical functioning among patients with SCI.⁵⁸ Likewise, in a systematic review of 17 studies addressing the impact of spasticity on QOL in adults with several chronic neurological conditions including SCI, spasticity was concluded to be associated with significantly lower scores on health status measures and on physical rather than mental components of the health status questionnaires.⁵⁹

Notably, spasticity was reported to be associated with poor QOL in studies using the criteria of interference with daily life (problematic spasticity) in the definition of spasticity,^{15,16} while no such association was reported when problematic spasticity was not specifically considered in assessing QOL.²⁰ Hence, given that spasticity can be experienced both as a negative and a positive condition depending on its severity,¹⁶ our findings emphasize the utility of MAS as a clinical tool for

Table 2 Patient characteristics with respect to quality of life scores.

Mean(SD)	WHOQOL-BREF Scores				
	Physical	Psychological	Social relations	Environment	Total score
Overall	44.3(12.5)	51.8(15.2)	50.4 (18.9)	46.8(14.5)	48.2(12.6)
Sex					
Male	46.2(13.5)	52.9(14.9)	50.9(18.0)	47.3(14.9)	48.86(11.75)
Female	41.7(12.5)	50.7(17.4)	49.1(17.4)	46.4(15.6)	47.20(13.69)
P value [†]	0.077	0.490	0.625	0.756	0.497
Educational status					
High school	43.2(14.2)	52.1(12.8)	53.2(18.5)	46.6(16.4)	48.4(14.9)
Vocational school	44.7(18.9)	51.7(18.8)	49.5(19.1)	46.8(13.8)	48.1(11.7)
P value [†]	0.581	0.887	0.369	0.937	0.900
Marital status					
Single/divorced	48.6(13.7)	52.9(19.3)	53.8(15.3)	47.0(16.7)	49.6(14.6)
Married	46.1(14.8)	53.7(18.1)	53.0(18.4)	48.1(15.7)	52.4(14.2)
P value [†]	0.759 [‡]	0.295 [†]	0.939 [†]	0.901 [†]	0.660 [†]
SCI aetiology					
Traumatic	44.2(13.4)	50.7(15.7)	48.3(18.1)	45.6(13.9)	47.1(12.6)
Non-traumatic [‡]	44.5(10.8)	53.7(14.1)	54.1(20.0)	48.8(15.3)	50.0(12.4)
P value [†]	0.900	0.323	0.122	0.253	0.237
AIS category					
Complete (A)	43.7(12.2)	52.4(12.6)	47.1(15.0)	43.5(11.8)	46.6(10.1)
Incomplete (B + C + D)	44.5(12.6)	51.6(15.9)	51.5(20.0)	47.8(15.1)	48.7(13.3)
P value [†]	0.787	0.804	0.301	0.186	0.464
Severity of spasticity					
MAS <2	46.5(10.9)	53.8(14.0)	53.8(17.3)	48.4(13.4)	50.6(10.9)
MAS ≥2	41.9(15.3)	48.8(16.2)	45.6(20.2)	44.2(15.2)	44.7(13.7)
P value [†]	0.029	0.090	0.025	0.127	0.014
Bladder management					
CIC	43.9(12.6)	51.0(14.2)	49.4(18.7)	46.4(13.7)	47.6(12.0)
Permanent catheter	29.8(13.5) [§]	44.4(33.4)	36.1(21.0)	44.8(30.4)	38.8(24.1)
Normal voiding	47.9(10.5)	55.7(16.1)	56.4(18.7)	48.4(15.5)	51.7(12.9)
P value [¶]	0.048	0.305	0.122	0.827	0.170

AIS, American Spinal Injury Association Impairment Scale; CIC, clean intermittent catheterization; MAS, Modified Ashworth Scale; SCI, spinal cord injury. Values in bold indicate statistical significance (P < 0.05).

[†]Independent t test.

[‡]Cervical/lumbar disc herniation, iatrogenic SCI (failed neck surgery, thoracic spine surgery, failed back surgery and scoliosis/kyphosis surgery) and tumor.

[§]P < 0.05 compared to normal voluntary voiding.

[¶]ANOVA test.

quantifying spasticity and thus consideration of spasticity severity in addressing QOL in post-SCI rehabilitation practice to provide better long-term care.^{4,16,25}

Table 3 Correlation of WHOQOL-BREF scores with age, duration of SCI and MAS scores (n = 110).

WHOQOL-BREF Scores		Age	Duration of SCI	MAS
Physical domain	r	-0.065	0.083	-0.218
	P	0.498	0.389	0.029*
Psychological domain	r	0.03	0.152	-0.090
	P	0.753	0.114	0.347
Social relations domain	r	0.025	-0.023	-0.216
	P	0.793	0.813	0.023*
Environment domain	r	0.055	-0.007	-0.150
	P	0.568	0.938	0.117
Total scores	r	0.023	0.055	-0.215
	P	0.812	0.566	0.022*

MAS, Modified Ashworth Scale; SCI, spinal cord injury; r, correlation coefficient; P, Pearson correlation analysis.

*Statistical significance (P < 0.05).

Choice of bladder management technique compatibly with patient age, preference and motivation as well as with economic and functional status is important in the management of urologic dysfunction among patients with SCI.^{60,61} In our study, only 20.0% of patients reported normal voiding, while 80.0% required catheterization to facilitate bladder emptying. Use of CIC for catheterization in the majority of our patients seems consistent consideration of CIC as the safest method for bladder emptying and assisted bladder voiding for SCI patients in terms of urological complications.^{5,62-64}

Nonetheless, supporting the negative impact of bladder dependence on several QOL domains,¹⁴ the presence of normal voluntary voiding predicted better QOL in terms of the physical domain in our cohort. Similarly, voluntary voiding was reported as one of the determinants of a high life satisfaction in SCI patients in a previous study.⁶⁵ SCI patients who had voluntary voiding compared to those who required

Table 4 Regression analysis for factor predicting lower WHOQOL-BREF scores.

Variables	WHOQOL-BREF scores								
	Physical domain [†]			Social relations domain [‡]			Total scores [‡]		
	B	SEM	P	B	SEM	P	B	SEM	P
Constant	51.577	6.658	< 0.001	72.869	8.825	< 0.001	60.936	5.999	< 0.001
MAS (high vs. low)	−11.518	3.834	0.005§	−17.965	5.866	0.004§	−11.381	3.988	0.007§
Bladder management (voluntary voiding vs. catheter)	3.597	1.862	0.042§	-	-	-	-	-	-

MAS, Modified Ashworth Scale; B, regression coefficient; P, significance level; SEM, standard error of mean.

[†]Multiple linear regression analysis.

[‡]Linear regression analysis.

§Statistical significance (P < 0.05).

manually assisted voiding, catheterization, or a urine-collecting apparatus were also shown to have better WHOQOL-BREF scores in terms of physical, psychological, and social domains.⁶¹

Hence, our findings support the likelihood of urological dysfunction after SCI to be associated with an increased risk of long-term complications and decreased psychological and social well-being.^{5,64} This seems to emphasize the role of close monitoring and appropriate management for bladder dysfunction in achievement of improved QOL among patients with SCI.^{5,64}

In a systematic literature review of 14 articles reporting on 13 QOL instruments in individuals with SCI, the WHOQOL-BREF was reported to be the most acceptable and established instrument to assess QOL after SCI.¹⁰ WHOQOL-BREF total scores in our cohort, even in patients with severe spasticity, were better than those reported in similar studies addressing QOL in SCI patients using WHOQOL-BREF,^{41,50,61} This supports the variability in QOL after SCI that ranges within a spectrum of recovery outcomes from scores below the normal range to those exceeding the healthy population averages.^{10,66}

A major strength of the present study is the consideration of spasticity severity determined via a reliable and valid clinical tool (MAS) in assessing the QOL in a relatively large sample of SCI patients with spasticity. This allowed more accurate assessment of QOL alterations post-SCI in patients with spasticity given the likelihood of spasticity to be experienced as a negative or a positive condition,¹⁶ and a spectrum of recovery outcomes in QOL after SCI.^{10,66} However, certain limitations to this study should be considered. First, the cross-sectional design made it impossible to establish any cause and effect relationships. Second, lack of data on other variables with a potential impact on QOL such as anxiety, depression, social support and physical activity participation is another limitation that otherwise would extend

the knowledge obtained in the current study. Nevertheless, given the lack of a national SCI registry in Turkey and limited data available on this subject, our findings represent a valuable contribution to the literature.

Conclusion

In conclusion, addressing QOL in relation to severity of spasticity for the first time among Turkish patients with SCI, our findings revealed a negative impact of spasticity severity on WHOQOL-BREF scores, particularly for physical health and social relationships domains. Our findings highlight the importance of considering spasticity severity in addressing QOL in rehabilitation practice and the likelihood of reduction in spasticity severity and appropriate management for bladder dysfunction to yield improved QOL in patients with SCI. There is a need for future larger scale studies addressing the utility of both objective and subjective psychometric tools in quantifying spasticity in SCI patients and the QOL-related outcomes of appropriate management.

Disclaimer statements

Contributors None.

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Conflicts of interest Authors have no conflict of interests to declare.

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